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Validation of the U.S. Army's Current Hazardous Waste Data

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The objectives of this research were to (1) critically examine the Army's current data on the generation and storage of hazardous wastes, (2) identify problems and recommend potential improvements in the way the Army collects, compiles, and distributes hazardous waste data, and (3) develop a simple, rational methodology for prioritizing wastes in terms of their potential threat to the public health and environment, and potential liability to the Army.

Although data indicates that the quantity of waste increased in spite of the Army's strong emphasis on the hazardous waste minimization program, the increases were mainly due to the lack of resources and poor systems to monitor and record hazardous waste quantities and did not represent actual quantity increases. This study recommends methods to improve the accuracy of Army hazardous waste generation quantity data.

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FOREWORD

This project was conducted for the Office of the Chief of Engineers (OCE), Army Environmental Office, under Project 4A162720A896, "Environmental Quality Technology"; Work Unit B-053, "Hazardous Waste Minimization Technology." The Army Environmental Office Technical Monitor was Robert Lubbert, ENVR-EH.

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VALIDATION OF THE U.S. ARMY'S CURRENT HAZARDOUS WASTE DATA

1 INTRODUCTION

Background

As part of the Hazardous and Solid Waste Amendments (HSWA) of 8 November 1984, codified on 15 July 1985, generators are required to certify on the hazardous waste manifest (tracking document) that they have adopted a waste minimization program. As stated in the appendix of 40 Code of Federal Regulations (CFR), Part 262, generators of more than 1000 kilograms (kg) of hazardous waste per month are required to sign a statement on the manifest which reads "...I also certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and I have selected the method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment." Additionally, each generator must prepare a biennial report, including a description of its waste minimization program, in accordance with 40 CFR, Part 262.41(a). This description must include the efforts undertaken to reduce the volume and/or toxicity of the wastes generated and the changes in waste volume and toxicity actually achieved compared to previous years.

The Department of the Army (DA) goal is to achieve a 50 percent reduction in hazardous waste generation by the end of calendar year 1992 (CY 92), as compared to the "baseline" year of 1985. Several Armywide and installation-specific actions have been undertaken to reach this goal. However, to comply with Federal requirements and achieve the reduction goal, the Army needs accurate data on the types and quantities of hazardous wastes being generated at all installations and of the inventories of such materials being stored pending treatment, disposal, or final disposition by the Defense Reutilization and Marketing Offices (DRMOs). Accurate, uniform, and consistent reporting of hazardous waste data by all installations will be critical, especially when the waste component of the Army Environmental Data Management System (AEDMS) is used to better manage Army hazardous waste data. Each installation must count the same type of waste in the same manner so that reliable comparisons among installations and summaries across the Army are possible. However, current hazardous waste data is not accurate or complete because the Army has no detailed standards for accounting and reporting.

To effectively manage an overall hazardous waste minimization (hazmin) program, the Army must know how various wastes compare in terms of potential threat to human health and the environment and in terms of the difficulty of acceptably and economically reducing the generation rate and/or toxicity. A priority ranking of hazardous wastes will become a consideration in the Army hazmin management system.

Objectives

The objectives of this research were to:

1. Critically examine the DA's current data on the generation and storage of hazardous wastes on its installations,

2. Identify problems and recommend improvements in the way the Army collects, compiles, and distributes hazardous waste data in order to better support Army hazardous waste management and minimization programs, and

3. Develop a simple, rational methodology for prioritizing wastes in terms of their potential threat to the public health and environment, and potential liability to the Army, and to demonstrate this prioritization using wastes typical of those generated by the Army.

Approach

To accomplish the objectives, information on the Army's generation and storage of hazardous wastes was gathered from various sources. A major source consisted of the responses by Army installations to a message/questionnaire coordinated by the Army Environmental Office (AEO) in November 1987. This AEO message (Appendix A) requested that each installation supply information regarding the volume of hazardous wastes generated; types of wastes; storage locations; quantities treated, disposed of, or recycled; associated costs; and hazmin actions planned or implemented. Related documentation (Federal and State laws, Department of Defense [DOD] regulations, Army and General Accounting Office audit reports, and other DA and/or major command [MACOM] studies) were used to examine and analyze the AEO data collected for Congress and installation hazardous waste profile data presented to the Vice Chief of Staff in 1987.

To validate this data, researchers visited two MACOMs and six installations and conducted telephone interviews with selected installation waste managers as described in Chapter 2. A DRMO was also visited. Sample hazardous waste manifests and reporting forms and a methodology to help prioritize waste minimization and disposal efforts were then developed.

Mode of Technology Transfer

The recommendations in this report will be considered for inclusion in the AEO hazardous waste management plan to improve the quality of Army hazardous waste minimization data.

2 DATA VALIDATION

The AEO received responses to its message requesting hazardous waste data from 112 Army installations; additional responses were received from National Guard activities. These responses formed the basis of the *Program Status Report, Department of the Army Hazardous Waste Minimization.*[1] As concluded in that report, nearly 90 percent of the hazardous wastes generated within the Army between 1985 and 1987 were from Army Materiel Command (AMC) installations. FORSCOM and TRADOC generated 5 and 2.5 percent, respectively. The report also showed that the Army hazardous waste generation quantity in 1985 (the baseline quantity for the hazardous waste minimization program) was 59,630 ton and that the quantities in 1986 and 1987 were 64,613 ton (an 8 percent increase from baseline) and 88,264 ton (a 37 percent increase from the 1986 quantity; 48 percent increase from the baseline), respectively. Considering the Army's emphasis on and achievement in the hazardous waste minimization program, the generation quantities in the AEO report do not make sense.

Researchers interviewed environmental management officers and environmental coordinators at the following installations and MACOMS representing differing missions and reporting methods:

AMC
- Headquarters, Alexandria, VA
- Depot Systems Command, Red River Army Depot, Environmental Management Office, Texarkana, TX
- Armament, Munitions, and Chemical Command, Lone Star Army Ammunition Plant, Environmental Management Office, Texarkana, TX
- Laboratory Command, Harry Diamond Laboratories, Environmental Management Office, Adelphi, MD

FORSCOM
- Fort Hood, Environmental Office, Killeen, TX

TRADOC
- Headquarters, Facilities Engineering, Fort Monroe, VA
- Fort Belvoir, Environmental Office, Fort Belvoir, VA (Fort Belvoir is now under the authority of the Military District of Washington)
- Fort Lee, Environment Office, Fort Lee, VA

DRMO
- Fort Hood, TX

A questionnaire (Appendix B) was developed to be used as the basis for the interviews and was sent to each site before the visit. Installation representatives were not asked to fill out the questionnaire, but only to review it. During the site visits, researchers used the questionnaire as a starting point for other informative discussions. The questions focused on collecting and compiling data used to respond to the AEO message, hazardous waste reporting requirements at the installation, hazardous waste management procedures at the installation, waste disposal costs, and other information pertaining to the potential human and environmental threat of the various wastes generated at the installation.

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[1] *Program Status Report, Department of the Army Hazardous Waste Minimization* (Army Environmental Office, August 1988).

Researchers analyzed the message responses and interview information using five broad questions. The following paragraphs contain the questions and the related discussion.

1. Are similar installations reporting similar generation? Where they are not, why not? Are some wastes underreported for some sites? Does it appear that all respondents are reporting on the same basis?

Between December 1987 and March 1988, installations received many requests and requirements to prepare reports on hazardous waste generation and disposal. Some installations noted they had up to seven such reporting requests within this time. The AEO requirement for information on hazardous wastes was viewed as additional and "unnecessary" work by many installations. Therefore, some installations did not carefully prepare the data.

Installations in states that have strict hazardous waste reporting requirements provided the most complete responses to the AEO message. For example, Texas requires a comprehensive and detailed annual report from any waste generator, so installations in Texas have kept detailed records for many years. The information was readily available to respond to such queries as the AEO message.

Installations that routinely track hazardous waste generation, storage, transport, treatment, and disposal by means of an installation waste manifest record or system tend to keep complete, accurate information on waste generation, treatment, and storage. For example, both Harry Diamond Laboratory and Red River Army Depot have an installation waste manifest form that the Environmental Management Office completes for each waste as it is generated. Consequently, these installations also have very comprehensive records.

The AEO message asked that the data be categorized in accordance with 40 CFR, Part 261, the USEPA list of hazardous wastes. Personnel at most sites indicated that although the USEPA list is extremely long, they had no particular problem using it. However, many sites do not have computerized data bases from which to generate this type of information. Further discussions revealed that some installations choose waste categories such as D001 (Ignitable) as a "catch all" category to report material for which they do not have adequate information. Generally, AMC installations have the knowledge and equipment needed to analyze and adequately characterize hazardous material; FORSCOM and TRADOC installations do not, and this complicates the identification procedure for them.

The Army has three categories of hazardous waste generators. The first is the troop unit, generating waste solvents, paints, fuel and oils. The second category is the refurbishing facility and manufacturing facility generating industrial wastes (the Army's largest hazardous waste generator accounting for about 90 percent of the total). This generator category is the most knowledgeable and best equipped to handle hazardous waste disposal. The third category is supporting activities such as laboratories generating spent chemicals and hospital and craft shop wastes in small quantities.

AMC (nonindustrial operation), TRADOC, and FORSCOM use similar hazardous materials that ultimately become hazardous wastes. Examples of such wastes are those associated with vehicle maintenance/transportation, battery acid treatment, painting wastes, cleaning and degreasing materials, and demilitarization of explosives. The main difference between the MACOMs regarding these common wastes is the quantity generated. Industrial wastes occur primarily within AMC.

None of the installations indicated whether a disposal action was one-time or recurring. The TRADOC and FORSCOM units did not consistently report materials being recycled as hazardous waste

generation, but rather only reported those quantities being sent to disposal; AMC reported all of the material generated, if it was reportable under the applicable regulations. As a result, "pink and acid waters" were reported even though they were treated onsite and did not leave the installation as hazardous wastes. Such data, when compiled into tables, showed small amounts generated yet large amounts treated. In most cases, one-time disposal was not treated as a separate category and was reported as if it were a yearly occurrence. Finally, some of the hazardous waste generation may have occurred in one year and the actual disposal in the next year. Since this was not reflected in the individual data submittals or notations, comparing generation to disposal or treatment values did not necessarily balance when the data was tabulated.

Each MACOM and installation was asked to report the same types of data. The respondents were to provide installation identification information, the quantity and type of waste generated, and data on wastes received by that installation from off site. The data were to include: amounts disposed of by the MACOM and/or DRMO; amounts recycled, reused, or reclaimed; the associated respective costs; and information on minimization initiatives, including: proposed projects, cost savings, impediments, and incentives. Unfortunately, all installations did not interpret the AEO requirements similarly. Consequently, some reported only material delivered to a DRMO while others provided detailed information, usually from computer generated data, that gave explicit detail on the hazardous materials generated, treated, and disposed of by the installation.

Because of the way the questions on generation of wastes were asked in the AEO message, and subsequent confusion and misinterpretation at the installations, quantities of hazardous wastes generated reported by some installations were greater than the actual amount of hazardous wastes for treatment and/or disposal. For example, a production line at Lone Star Army Ammunition Plant treats pink water and generates contaminated carbon and sludges as a result of the pink water treatment. The State of Texas requires reporting of contaminated carbon, sludges, and pink water volume. However, contaminated carbon is regenerated by a supplier and the treated pink water is discharged to a receiving water body. When the hazardous waste generation quantity is defined as the disposal quantity, only the sludge volume should be counted as a generation quantity. If treatment and recycling volumes are separately counted as a generation quantity, the Army will be able to maintain more accurate data without confusion.

Installations with strong central management of hazardous wastes have better and more accurate recordkeeping and reporting methods than installations with decentralized management. For example, the Fort Hood Environmental Management Office maintains centralized control and accurate records of all hazardous waste treatment, storage, and disposal for all units, tenants, and organizations using the installation for training exercises. However, the office only reports material turned in for disposal as excess or hazardous waste, not the generation of such wastes.

2. Are the absolute as opposed to the relative quantities reported credible? If not, why not?

Table 1 presents a subjective summary of the AEO-requested hazmin reporting by installation. Each report was reviewed by the researchers for the following: completeness, correct data format, accuracy of calculations or summations, and amount of data relative to installation size and/or known operations. To develop this table, certain definitions were subjectively determined and three ranking categories, Good, Partial, and Inadequate were established. These three categories are defined as follows:

- Good data appeared to be complete and seemed to provide an adequate portrayal of the hazardous materials/wastes and installation projects. This definition does not mean the data was accurate, only that reasonable numbers were provided.

Table 1

Hazardous Waste Minimization Reporting

MACOM/SUB	Good	Partial data	Inadequate
TRADOC	Ft. Belvoir Ft. Benjamin Harrison Ft. Benning Ft. Knox Ft. McClellan Ft. Monroe Ft. Sill	Ft. Bliss Carlisle Barracks Ft. Chaffee Ft. Dix Ft. Eustis Ft. Gordon Ft. Leavenworth Ft. Lee Ft. Leonard Wood Ft. Rucker	Ft. Hamilton New York Activity Center
FORSCOM	Ft. Campbell Ft. Carson Ft. Drum Ft. Hood Ft. McCoy Ft. Polk Ft. Richardson Ft. Stewart Ft. Wainwright	Ft. AP Hill Ft. Irwin Ft. Bragg Ft. Lewis Ft. Meade Ft. Ord	Ft. Buchanan Ft. Devens Ft. McPherson Ft. Riley Presidio S.F. Ft. Sam Houston Ft. Sheridan
AMC			
AMCCOM	Badger AAP Holston AAP Indiana AAP Joliet AAP Kansas AAP Lake City AAP Lone Star AAP Louisiana AAP McAlester AAP Milan AAP Riverbank AAP Sunflower AAP Watervliet Arsenal	Hawthorne AAP Iowa AAP Longhorn AAP Mississippi AAP Newport AAP Pine Bluff AAP Radford AAP Ravenna AAP Scranton AAP Twin Cities AAP Volunteer AAP	Cornhusker AAP Rock Island Rocky Mountain Arsenal St. Louis AAP
DESCOM	Anniston AD Corpus Christi		Sacramento AD

Table 1 (Cont'd)

MACOM/SUB	Good	Partial data	Inadequate
DESCOM (cont'd)			
	Letterkenny AD		
	Lexington/Blue-grass AD		
	New Cumberland AD		Pueblo AD
	Savanna AD		
	Seneca AD		
	Sharpe AD		
	Red River AD		
	Sierra AD		
DECOM	Tobyhanna AD		
	Tooele AD		
	Umatilla AD		
LABCOM		Harry Diamond Lab	Army Materials Tech Lab
TACOM	Detroit Arsenal	Detroit ATP	
		Lima ATP	
MICOM	Redstone Arsenal		
TECOM	White Sands MR	Dugway PG	
	Aberdeen PG	Jefferson PG	
		Yuma PG	
CECOM			Ft. Monmouth
AVSCOM		Saginaw AAP	
		Stratford AAP	
MTMC	Oakland AB		
	MOT Bayonne		
	MOT Sunny Point		
AISCOM		Ft. Huachuca	
TROSCOM	USABRDEC		
	Natick RD&E C		

Table 1 (Cont'd)

MACOM/SUB	Good	Partial data	Inadequate
OCONUS		USARJ	Heidelberg EUSA Panama Mainz
Others			INSCOM WESCOM USMA

• Partial is just as the name implies--either data is missing, was not reported, or the installation reported that the data was not available, without any further explanation. The installation did, however, provide some data useful for the Hazmin Status Report. Finally,

• Inadequate means that either no data was provided or that researchers were unable to assess what wastes were reported.

Out of the 112 replies, 51 were Good, 37 were Partial, and 24 were Inadequate. With less than 50 percent of the responses in the Good category, the apparent overall accuracy of the data is suspect. Upon closer examination of the data by year, 1985 appears to be the poorest, 1986 slightly better, and 1987 the most accurate and complete. AMC's hazardous waste data, which accounts more than 90 percent of the total Army generation, is considered to be in the Good category, especially in 1987.

Armywide data from 1985 and 1986 was not always available due to changes in the functional office or personnel directly involved, lack of adequate data, or misinterpretation of the AEO message. An example of how functional offices or personnel changes impacted the requested information was the mid-1986 switch of the hazardous waste management responsibility from the Installation Services Activity (ISA) to the Directorate of Engineering and Housing (DEH), as occurred at the Harry Diamond Laboratory and Fort Lee. Many installations, who are small quantity generators and are not required to report to either state or USEPA Offices, had inadequate records from 1985. Finally, FORSCOM and TRADOC installations generally reported hazardous materials/wastes turned in to the Environmental Office (EO), not hazardous waste generated as requested by the AEO. Some installations considered all material as hazardous waste when turned into the DRMO even if it was recycled, transferred, disposed of, or sold (RTDS). Some installations turned the hazardous waste in to DRMO, then considered DRMO responsible for the waste and credited themselves for a minimization action. On the other hand, some installations followed the hazardous waste to its final fate and reported the data accurately, as requested in the AEO questionnaire. There is still some confusion at installation environmental offices about how and what to report when items are turned in to DRMO. Some still report material turned in as the generated amount, some use the manifest totals as disposal numbers even if they contain other agencies' waste, and others take credit for minimization even if the waste is ultimately disposed of by DRMO.

Many installations stated that the response to the AEO message was estimated from a combination of the data on DD Form 1348-1 and an examination of the items in storage for disposal. Several TRADOC installations answered the AEO message this way because of the short response time.

As noted earlier, Armywide data concerning hazardous wastes for the year 1985 is incomplete and inaccurate. Various reasons were presented during the onsite discussions to account for the inaccurate data: records were not maintained and kept from 1985, responsibility for hazardous waste management was switched between directorates and records for 1985 data were lost or destroyed, personnel were unfamiliar and inexperienced with identification and reporting of hazardous wastes, and small quantity generators have not been required to report their generation levels so records concerning turn-in and disposal of hazardous materials/wastes were not maintained.

3. Is all waste reported under a given category comparable? Is there an appropriate balance between aggregation and disaggregation of wastes such that the information needed to make good decisions is available?

All Army facilities have a common problem in that the amount and type of hazardous wastes disposed of is not consistent from year to year. For example, troop units were frequently shifting location, generating different types of waste at various sites; the laboratories were involved in extensive campaigns to turn in excess hazardous material; and manufacturing functions were performed on a low volume basis to maintain stocks, with some new plants coming on line and some going off during the period. These fluctuations will always be a problem. However, with increased awareness of hazardous waste Armywide, efforts to reduce excess hazardous materials have increased. In TRADOC and FORSCOM, the EO will not accept hazardous material for disposal unless it has been identified or has the original label intact. The unit turning in material is responsible for proper identification of the material if its chemical nature cannot be readily established. AMC installations, on the other hand, often have easier access to analytical capability (in-house), resulting in either well defined hazardous material/waste or the ability to identify the compounds in their own laboratories. Listing the wastes in the correct categories is a problem because the wastes often are mixtures that potentially may be classified in more than one category.

Most Army installations use the USEPA Waste Identification Numbers to identify and report hazardous waste being generated. Because some states (e.g., Texas) are more restrictive than the Federal government regarding what constitutes hazardous wastes, a wider variety of wastes may be reported as "hazardous." Overall, however, most installations use chemical analysis to identify the components of hazardous wastes, and thus correctly identify and categorize them.

Installations report industrial waste sludge generation in a variety of ways. Some report generation when the sludge is actually picked up for disposal, which might be once every other year. Some installations do not report sludge generation, but report only the end product from the treatment of the sludge, such as spent lime. And some installations that generate industrial sludge do not report it since the State does not require them to do so. Specifically, small plating operations generate waste sludges. For TRADOC installations, the volume of plating waste sludge is often small. If the installations have little else to report, they are below the quantities required for mandatory reporting. This is especially true when they treat the liquid waste from plating and produce minimal quantities of disposable sludge. Certain states require the liquid waste to be reported as generated volume and weight, but in other states, the sludge is generated in such a small amount that reporting is often not required at all. Since the liquid waste is not disposed of by manifest, but is usually released into the sewer system after heavy metals are removed, there is no record of generation or disposal unless the operator takes the responsibility to log all of the information and send it to the EO for consolidation.

Hazardous wastes are variously reported in either English or metric system units. Most installations prefer to report in English units since the State reports require English units. Converting to metric units is time consuming and can lead to errors. Some installations presented values without units; calls were made to the installation to determine if they were reporting in the AEO requested units. If the unit was tons, metric tons was assumed. The error introduced by this assumption would be slight overall and less than the error in compiling the data initially.

4. What is the relationship between the installation and the DRMO? Findings regarding how installations view the relationship between the installation and DRMO, with regard to waste management, are as follows:

Few installations receive a completed copy of the DD 1348-1 they presented to DRMO or the Defense Reutilization and Marketing Service (DRMS) when a material/waste is turned over. Thus, they do not know if or when a material is ultimately declared a hazardous waste.

Before a hazardous material can be declared a waste, DRMO must first determine if it can be reutilized, transferred, donated, or sold. If it cannot, DRMO will then declare it a waste and dispose of it appropriately.

Many installations do not fully understand what constitutes a "hazardous waste" by DRMO's definition. This is a two-way problem: many installations are not aware of the DRMS list of 13 items that are automatically declared hazardous wastes (such as friable asbestos, hardened paints, certain fire extinguishers, etc.); and, DRMS does not classify hazardous wastes according to any specific USEPA listing.

Installations that have a very good working relationship with the DRMO have a more complete record of disposal of hazardous wastes. For example, an installation environmental officer declares that the DRMO service and relationship is good, and that he is aware of the kinds and amounts of materials that become disposed of as hazardous waste through DRMO. In contrast, the installation environmental officer at another installation which is serviced by the same DRMO, declares that the working relationship and service are less than ideal. The environmental officer experiences difficulty in obtaining contracts for material pick-up, and is usually not notified of the ultimate fate of items that go through the DRMO.

Most installation environmental offices do not know the amounts nor see the funds that are returned to an installation from DRMS through the resell/recycle program.

Installations that do not have a DRMO onsite complained that DRMO takes too long to let a service contract. This is a serious issue for many installations that incur violations to the 90-day short term storage regulations because of the delays in service. The installations view this as unfair since DRMO is accountable for the items, but because of physical location of the storage, the installation receives the violation notice.

Many installations, especially those without a DRMO onsite, request that they be allowed to award their own service contracts for hazardous waste disposal.

Most installations felt that hazardous waste storage capacity at the installation was adequate, even when DRMO was slow in awarding service contracts. The others felt they should have their own approved Resource Conservation and Recovery Act (RCRA) storage facility.

Most installations felt that transportation of their hazardous wastes presented no undue threat to the environment or to humans. Installation environmental officers stated that only qualified and licensed transporters are awarded the transport contracts. Some installations conduct quality assurance/quality control checks by inspecting transport vehicles occasionally to make sure that the vehicles can safely transport the wastes.

The turn-in and disposal form, DD 1348-1, is an accurate record for transferring materials. It does not, however, present an accurate record of wastes being generated and/or treated at an installation because it does not contain all the required reporting information.

Very few installations can present data on hazardous waste disposal costs. Installations currently do not directly fund most of the costs for hazardous waste disposal and thus do not keep adequate cost records. Also, the servicing DRMS does not notify installations of their proportional cost of many of the hazardous waste disposal contracts. DRMO, which often uses a single contract that lumps waste disposal services from all of the supported installations, also does not notify the installations. Very few installations can present data on the costs and return of monies from recycling and resell programs since DRMS does not provide this information to them except informally.

5. Is the data reported actionable? Can it be related to specific activities and processes that can then be modified to reduce the volumes or toxicity of waste produced?

Installation environmental coordinators state that the Hazardous Waste Minimization action committees do not meet regularly; sometimes only every 18 months or so. Lack of command emphasis and support contribute to poor results.

In spite of the Army's efforts to minimize hazardous waste generation, the quantities increased continuously in three years: 1985-1986 (8 percent) and 1986-1987 (37 percent). This was due more to the increase of reported quantity and less to actual quantity. The 1987 data was most accurate, and the data will become more accurate over time because MACOMs and installations are getting more resources in, and more attention will be paid to hazardous waste management. The AEO data was not detailed enough to relate to the specific activities and processes for implementing hazardous waste minimization programs.

3 PROBLEMS AND POTENTIAL PROCEDURAL CHANGES

Problems

Definition of Hazardous Waste Generation Quantity

The AEO message did not clearly define the hazardous waste generation quantity; however, the generally accepted definition is the disposal quantity of RCRA Army wastes. Based on the information gained during data validation, researchers identified the following issues that are related to the Army's incomplete hazardous waste management/minimization progress data. The problems revealed by this study were:

- Some state requirements were more stringent than RCRA requirements, and therefore, the state definitions might be different.

- Disposal quantity was not known to the installations because DRMO received hazardous items as hazardous materials and not as hazardous waste to maximize RTDS. Also, DRMO data was not separately maintained by installations.

- One-time generation quantity was included (e.g., spill debris). Therefore, the data did not clearly reflect the annual hazardous waste minimization result.

- Treatment quantity was included as disposal quantity. For example, industrial treatment plant effluent volume was reported as generation quantity.

Internal Tracking/Manifests

Army policy does not require installations to develop an internal hazardous waste tracking system. It should be pointed out, however, that regulations already exist that require accurate manifesting of waste. A report by Kim, et al.,[2] contains several significant related points that bear repeating. First, 40 CFR Parts 260-280 requires generators to use a manifest system to track hazardous waste from cradle-to-grave. Although a manifest probably would not have provided all of the data AEO requested, it should have quantified the waste. AR 420-47[3] provides guidelines for developing an installation hazardous waste management plan containing data that could have been used to provide the requested information.

A manifest generally is not used within DOD facilities except to ship hazardous waste to disposal facilities. DRMOs manage the manifests and have no established system to correlate the information with generation data from installations. Frequently, manifests contain information on wastes from several sending facilities with no indication of who provided what wastes. The installations do not use a consistent definition of hazardous waste. When manifests were checked with various other sources (such as Hazardous Waste Minimization Plans and Headquarters data), it was apparent that no one correlated any of the data.

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[2]B. Kim et al., *Conceptual Basis for a Hazardous Waste Component of the Army Environmental Data Management System (AEDMS)*, USACERL Technical Report N-88/23/ADA200435 (U.S. Army Construction Engineering Research Laboratory [USACERL], September 1988).

[3]Army Regulation (AR) 420-47, *Solid and Hazardous Waste Management* (Headquarters, Department of the Army [HQDA], 1 December 1984).

The two MACOMs interviewed have set no requirement for installations to develop an internal installation hazardous waste tracking system, but find that installations that have such systems have more accurate information and reports on hazardous wastes. However, regulations already exist which require manifesting.

Disposal

TRADOC believes there is a serious problem with the service installations receive from DRMOs. AMC sees the service working well when the DRMO is onsite, but the service breaks down when the DRMO is located away from an installation. Both MACOMs view the delays in waste pickups at installations as a major stumbling block in hazardous waste management and accounting at the installation level.

The DOD has mandated that the Defense Logistics Agency (DLA) dispose of hazardous wastes for the Army. In this capacity, DLA disposes of approximately 15 percent of the Army's hazardous waste through the DRMS and the local disposal agents, the DRMOs.[4] Specific hazardous wastes not handled include: industrial plant sludges; contractor generated wastes; wastewater treatment sludges; refuse from mining; dredging, construction, and demolition (excluding friable asbestos) wastes; unique wastes from research and development; hospital and medical wastes; municipal wastes; materials that cannot be disposed of in their present form; and toxic, biological, radiological,and lethal chemical warfare materials.[5]

Once an item is turned in to DRMO, accountability for the item is passed to DRMO. However, in many cases installations have the custody of the items and regulatory agencies may enforce regulations upon installations, not DRMO. When an Army installation turns an item in to the DRMO for disposal, a block on the DD 1348-1 is checked to identify the item as a hazardous waste, according to the DRMS hazardous waste definition, or as a hazardous material. According to DRMS Regulation DRMS-H 4160.3, Vol I, the items that are automatically declared hazardous wastes, and go directly to abandonment or destruction and disposal (via a service contract) are:

- Selected PCB's, as defined by DRMS
- PCB floor-sweeping compound
- Discharged or expended shelf-life lithium batteries
- Suspended/canceled pesticides that have no USEPA approved uses
- Friable asbestos
- Friable asbestos-containing items as defined by DRMS
- Spill residue
- Hardened paints that are unusable or not economically recyclable
- Chlorobromomethane fire extinguishers that have not been drained of all residues and depressurized by removing the valve assembly
- Carbon tetrachloride fire extinguishers
- 2,4,5-T (2,4,5-Trichlorophenoxyacetic acid)
- EDB (Ethylene Dibromide)
- Dinoseb and its salts plus all its formulations

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[4]*Program Status Report, Department of the Army Hazardous Waste Minimization.*
[5]AR 420-47.

- Chlorobromomethane (liquid)
- Pesticides not in original containers and whose composition may differ from that identified on the label.

All other items turned in to DRMO must be processed through the RTDS cycle. If items cannot be processed through the cycle, DRMS may declare them hazardous wastes and dispose of them. DRMS retains accountability for the items. There is no specific procedure for reporting back to the installations the quantities of hazardous materials later declared to be hazardous wastes by DRMS.

The following points emerged from the interview of the DRMO property disposal agent at Fort Hood:

- Only 13 categories of items are automatically considered hazardous waste by DRMS. All other items turned in are considered able to be RTDSed. If an item cannot be RTDSed, it is declared a waste and is disposed of through a waste disposal contract.

- The DRMS Headquarters in Battle Creek, MI, receives an accounting of which items are RTDS and which are declared waste. Fort Hood is not informed directly when items are declared waste. Another problem arises when the installation has less than 453 kg (1,000 lb) of waste. They have to assume the waste is part of the next manifest shipment by the DRMO, which is only a consolidated manifest, or as other agencies do, they report the material as disposed of on the date DRMO takes possession.

- DRMO does not accept sludges, trash, household wastes, or industrial wastes from manufacturing operations. Installation treatment and disposal of hazardous waste is not DRMO's responsibility and they do not account for it.

- The Fort Hood environmental office receives a copy of every manifest (off-base transfer) and cosigns the manifest. However, DRMO does not manifest shipments under 453 kg, unless these are on USEPA's P or U list of wastes, or unless the wastes are on the DRMS list of 13 hazardous waste items. Manifests from DRMO contain Department of Transportation (DOT) codes. USEPA list codes are provided when known, but because of the potential for items to be listed under several codes, the codes do not always agree with what the installation reports.

- The DRMO does not send a regular report to either USEPA or the state of Texas because regulatory reporting and recordkeeping is the Installation Commander's responsibility.

- Service contracts for disposal are awarded through DRMS Headquarters in Battle Creek, MI.

Procurement

A problem common to all of the installation environmental offices was "local procurement." Installation Commanders currently may authorize first-line supervisors to procure items up to $25,000 on local purchase. Supervisors who are not aware of the problems of hazardous waste may often unwittingly contribute to the problems by ordering significantly more material than required and/or buying hazardous material, even when a suitable nonhazardous substitute exists. Tracking locally procured materials is difficult.

Hazardous materials are used for a wide variety of Army operations. For FORSCOM and TRADOC organizations, the main hazardous materials used are solvents, fuels, lubricants, paints, and pesticides. Many of the uses are common to troops anywhere in the world, resulting in significant quantities and needing greater minimization efforts. The most significant techniques to reduce the disposal of hazardous material/wastes are to recycle solvents and substitute nonhazardous material for hazardous material. The manufacturing and refurbishing activities of AMC use a multitude of materials. Reduction of hazardous material takes several forms such as recycling, reducing toxicity, and substituting nonhazardous products. The latter presents problems for the activities because the contract usually requires that specific materials be used in the process. If specifications are not modified to allow use of substitute nonhazardous material, even when the substitute will perform effectively, contractually, the specified hazardous material must still be used. The contracting process should be examined to determine if substitutions can be made without compromising the overall product or increasing cost accounting.

Reporting

Army installations should be aware of minimization reports and regulations and the AEO-requested data should have been consistent with reports previously prepared, or notations should have been made as to why the differences occurred. Regulations are also in place for good recordkeeping, but the Hazmin Status Report indicates that many of the preparers of the installation responses were not aware of these regulations or did not have the proper documentation to provide the requested information.

The U.S. Army Audit Agency presented a special report[6] to the Vice Chief of Staff. The purpose of the report was to evaluate the procedures used by Army installations to report data on the quantities of hazardous wastes generated and to determine if proper accountability for hazardous wastes was maintained. Conclusions presented in the report included: procedures for reporting the quantities of hazardous wastes generated had not been well defined; quantities of wastes reported were not accurate and could not be used on a competitive basis; there was no definitive requirement for the Army to maintain accountability over hazardous materials turned in to the DRMO; DRMS assumes responsibility for accountability when items are turned in to DRMO; and, hazardous materials do not become hazardous wastes unless they cannot be processed through the RTDS system. The conclusion was that accountability and reporting for hazardous wastes are not fully within the Army's control. Several suggested actions were presented in the report, including determining if the reporting requirement could be revised so that the DRMO sites could provide data directly for the Defense Environmental Status Report, with a copy being sent to the concerned installation.

Procedural Changes

Internal Tracking/Manifests

It is suggested that installations develop an internal hazardous waste tracking system. A standard installation manifest form will help provide required data to the DRMO's, higher headquarters, state agencies, and the USEPA for all waste generated on an installation. The installation manifest could be computerized and capable of being manipulated to provide required report formats either in hard copy or electronically. Implementation of a hazardous material tracking system should also be considered.

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[6]*Special Report: Management of Hazardous Wastes*, SO 88-700 (U.S. Army Audit Agency, 26 October 1987).

Disposal

Representatives at both TRADOC and AMC suggested that installations not be allowed to award contracts for hazardous waste disposal service. In most cases, installation personnel do not have the expertise to write and award such contracts. Additionally, the small generators would most likely pay a premium for disposal of small quantities of hazardous wastes. Meetings between DOD and DLA need to be established to accelerate contracting for disposal, especially at those installations where no approved storage facility is available. They should also discuss methods to return disposal information to the installations. Finally, they need to agree on common definitions and procedures that can be passed on to the installations.

DRMO should provide disposal quantity and cost data to installations.

Procurement

A suggestion requiring all supervisors authorized local procurement to sign a statement that the material they are ordering is not a hazardous material has been considered, but not adopted Armywide. Armywide adoption of such a requirement should be reconsidered.

Local purchase requirements should consider making the supervisor responsible for hazardous waste minimization and having him sign a statement that he has considered minimization before ordering hazardous material.

DLA should either remove hazardous material from the inventory when a suitable nonhazardous replacement is available or flag hazardous material to alert the installation that a suitable substitute is available.

Reporting

More specific definitions of hazardous wastes generation quantity should be prepared so that everyone is using the same reporting data definition. Army-wide hazardous waste data should be categorized as follows:

-RCRA waste disposal quantity (in-house, DRMO)
-Nonrecurring (e.g., spill debris) disposal quantity (in-house, DRMO)
-Non-RCRA (e.g., State unique) waste
-Treatment quantity (RCRA, non-RCRA) and
-Recycle quantity (RCRA, non-RCRA).

The Army supply system, installation environmental offices, and DRMO's respectively use the National Stock Number (NSN), USEPA code, and Contract Line Item Number (CLIN) to identify hazardous materials and wastes. Because there is no correlation among these three systems, it is suggested that the Army develop a reference to correlate NSN, CLIN, and USEPA code.

Regulations and guidance should constantly be updated. Commands should emphasize the need for accurate data collection and reporting.

Command Emphasis

Installations should emphasize the minimization program by placing the personnel and program under a command staff element and ensuring that all senior level personnel are reminded at least quarterly of the requirement to participate.

Funding

In prioritizing funding for hazardous waste minimization and environmental programs, TRADOC would like to see the installations defined as "small generators" of hazardous wastes in a separate category. This would ensure the small generators a share of the funding and would ensure that Armywide funding decisions are not based solely on large volume generation.

Monitoring the Progress of the Hazardous Waste Minimization Program

This report has shown that the hazardous waste generation baseline data was not reliable. The following method is suggested to analyze the progress of Army hazardous waste minimization program:

-Estimate annual hazardous waste minimization quantity based on installation data. Total estimated minimization quantity is a sum of annual minimization quantity for each project since 1985.

-Compile actual annual hazardous waste generation quantity data.

-Compare the total hazardous waste minimization quantity and the actual annual hazardous waste generation quantity to indicate the relative progress of hazardous waste minimization efforts.

The Congress mandated that the Army the reduce to hazardous waste generation by 100 percent every year from CY88. Therefore, the yearly goals in the ratio between the total hazardous waste minimization quantity and the annual hazardous waste generation quantity should be 30/70, 40/60, and 50/50 in CY90, CY91,and CY92, respectively. This relative goal has a greater advantage over a fixed baseline method because Army data is getting more accurate every year.

4 PRIORITIZING METHODOLOGY

It is almost impossible to prioritize and rank all hazardous wastes the Army generates because factors affecting priority vary widely for each situation. Previous attempts at prioritization by USEPA and the Air Force were mainly directed toward superfund/DOD Installation Restoration Program (IRP) sites and the resulting exposure to humans and the environment rather than the materials themselves.[7]

RCRA 3002 (b) requires that a generator reduce the volume or quantity and toxicity of waste generated to the degree determined by the generator to be economically practicable. DOD's policy considers liability, potential threat to human health and the environment, and resource conservation as important reasons for a hazardous waste minimization program. Furthermore, the policy requires that all waste streams be examined for hazardous waste minimization by 1992 as a management goal.[8]

Development of Methodology

The objective of prioritizing waste is to identify and rank those materials that:

1. Pose the greater threat to public health and/or the local environment,
2. Constitute a greater financial burden to the Army (overall),
3. Present the greater hazard relative to storage, treatment, and shipment/transportation,
4. Could be readily replaced with a material that exhibits and presents a lower degree of the above factors.

To identify those types of wastes that should be a priority for the Army Hazardous Waste Minimization Program, the issues that most strongly affect the handling of those particular wastes have been incorporated into a hazardous materials prioritization method (HMPM). The HMPM can be used by the Department of the Army to specify and rank those types of materials or waste streams that should receive priority for minimization. A hazardous waste minimization prioritization score can be calculated by scoring each type of material according to four factors (discussed later): cost, fate/mobility, public health threat, and essentiality.

First, the types of materials that will be included in the prioritization scheme must be defined and identified. Although the Army hazmin program targets RCRA wastes, the HMPM incorporates any generated hazardous materials in spite of some uncertainties.

One uncertainty results from inconsistent reporting. Any hazardous material may eventually become a hazardous waste. Recording the purchase, storage, treatment, or disposal of hazardous materials constitutes the cradle-to-grave approach that reveals the origin and ultimate fate of hazardous material handled by the Army. However, there are many unique tracking mechanisms with different units, special reports, or processes that identify the hazardous material at various stages.

Another uncertainty stems from the differing definitions of hazardous wastes, which often are unclear even under Federal guidelines. The Army's hazardous waste minimization program includes such wastes

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[7]USEPA, "National Oil and Hazardous Substances Contingency Plan, Appendix A, Uncontrolled Hazardous Waste Site Ranking System: A User's Manual," *Federal Register* 47:31219-31227, 1982; *User's Manual for the Defense Priority Model* (Oak Ridge National Laboratory, 1987).

[8]"Hazardous Waste Minimization," OASD Memorandum (6 February 1987).

as pink water, industrial sludge and wastewater (sewage treatment sludge not previously delisted), used oils/fuels, and other mixtures or miscellaneous waste such as ammunition crates contaminated with pentachlorophenol (PCP). These materials either are not defined as a hazardous waste, or the definition does not fit the common USEPA scheme.

The HMPM is designed to be most effective when used in conjunction with a suggested Installation Waste Disposal Manifest (such as that in Appendix C) and hazardous material data base information. If the waste composition is accurately defined (including mixture content) and the basic manifest information (such as volume/year generated) is readily available, the HMPM can also be used effectively. Mixtures of miscellaneous materials must be defined by the most hazardous, most prevalent contaminant.

A factor critical to the proper functioning of the HMPM is for the user to realize that both subjective and objective questions must be answered. The answers to many questions may not be easily obtained; however, relative estimates will serve the purpose. In addition, good reporting data, such as the cost of procuring, using, treating, and disposing of materials, will lay the foundation for the prioritization method.

Appendix D shows how the following four HMPM prioritization factors are rated.

1. Cost. The cost relevant to prioritization is based on:

- Overall volume of the waste generated per year on a percentage basis to allow calculation at both installation and Army levels (i.e., percentage total costs involved),

- Treatability, and recycling/reuse potential of the particular waste, and

- Unit cost of disposal based on the lowest to highest cost per pound.

The volume is heavily weighted in the score (up to 10 points) to assure that those wastes that constitute a large portion of the Army's or installation's waste are targeted and small volume wastes are not targeted unless influenced by a very high toxicity score.

If a material is readily treatable and the resulting waste does not pose a critical disposal problem, that material will receive a high priority score because it can be readily minimized.

The cost of disposal must be estimated based on the type of material, the hazards associated with transporting the material, and the specific geographical real estate where disposal will occur.

2. Fate/mobility. The fate/mobility of the particular material is based on its physical state (solid, liquid, or gas), containment type, volatility, and environmental persistence.

Containment types are divided into: lagoon/outfall, (i.e., put directly into the surrounding environment), landfill/underground tanks (contained, but having problems of leaching or leaking), drums/above ground tanks (contained but leaks will be observable), and miscellaneous.

Volatility is divided into three very basic gross-estimate categories: volatile-with-odor, volatile-without-odor, and nonvolatile.

Persistence of a material in the environment may be estimated by using the octanol/water partition coefficient (K_{ow}). This constant is simply a measure of the ratio of concentration of a chemical dissolved in octanol to the concentration of the substance in water. The concept is that a chemical substance that dissolves readily in octanol and is insoluble in water will tend to persist in the environment by bioaccumulation (settling in fatty tissues) or will be adsorbed on soils or organic matter. Experimental values for this measurement are available but may be difficult to find. However, the K_{ow} can easily be calculated if the solubility and molecular weight of the compound are known by the following calculations:

$$[S \div 1000(mg/g) \div Mwt \times 10^6\ \mu mole/mole = Sw(\mu mole/L)]$$

and

$$[\log K_{ow} = 5.00 - 0.67 \log Sw]$$

where S = solubility in mg/L (if solubility is listed as nonsoluble, use 20 mg/L)
Mwt = molecular weight
Sw = solubility in µmole/L
5.00 and 0.67 = empirically derived constants

If the solubility of a compound is low, and the molecular weight is high, the K_{ow} will be higher. For example, DDT is a compound that exhibits a very high K_{ow} and is known to have a very strong tendency to bioaccumulate and persist in the environment. Within the HMPM, such highly persistent materials would receive a higher prioritization score.

3. Public health threat. The public health threat is based on the issues of toxicity, chemical/physical hazard, and public health.

Toxicity is scored by whether or not the waste is a known carcinogen (see Appendix E) and by its mammalian and aquatic toxicity.

Hazard is defined by ignitability, explosiveness, reactivity, corrosivity, and radioactivity. Definitions of these categories are given in 40 CFR, Part 261.

Public health issues are defined by the priority pollutant list (see Appendix F) and whether or not the material or related waste is a known public health issue. Examples would be dioxins, polychlorinated biphenyls (PCBs), chemical or biological warfare agents, etc.

4. Essentiality. The essentiality of a particular material is based on the questions given in the prioritization example sheet in Appendix D. The questions are designed to determine if a particular material can be readily replaced by a material that is less hazardous. And, if there is a reasonable substitute, will that substitute be economically practical and will it produce acceptable quality of the end product. If a material is found to be nonessential and the substitute meets the requirements, it would receive a higher prioritization score.

The methodology for the HMPM consists of scoring each issue, totaling the scores for each characteristic, and summing the totals for all four characteristics (i.e., cost, fate/mobility, public health threat, and essentiality). The raw score, or the ratio of total score to possible score, can then be compared

to any other HMPM-scored material and the higher priority waste can be identified. The total possible score is 100 points. The materials can then be arbitrarily separated into high, medium, or low priority.

The HMPM was designed to handle any hazardous material generated by Army installations. Its flexibility lies in the key factor of identifying the most toxic, highest volume constituent of any hazardous waste mixture and applying the HMPM to that specific compound. The general issues of contamination and public health allow miscellaneous items to be scored. The toxicity scoring includes a median score if there is no information regarding the toxicity of that particular agent. If the compound is a carcinogen, it will automatically receive a score of 10. The mammalian toxicity score is ranked by 5 levels of LD_{50} score (LD_{50} = lethal dose causing 50 percent mortality of the test species). LD_{50}'s can be found for most compounds.[9] It is recommended that the lowest LD_{50} recorded using species closest to humans be used (i.e., chose dog or monkey LD_{50} over rat LD_{50}). If no LD_{50} can be found, a medium score of 5 will be given. Aquatic toxicity will be estimated as toxic or nontoxic. If no aquatic toxicity data is found, a score of 1 will be given. It should be noted that mammalian toxicity and aquatic toxicity are very different and that the species and route of exposure can radically affect the LD_{50}. Obviously, the HMPM attempts to minimize the subjectivity of the prioritization score. But the common sense, judgment, and experience of the HMPM user will be the deciding factor in the utility of the prioritization. Obviously, decisions must be made that are not clearly defined, particularly under the questions of essentiality and treatability. Further definition of these questions would involve research specifically designed to determine the availability of alternative technologies.

Although the HMPM is designed to be used at DA level, it can also be used at the MACOM or installation level, particularly if the volume ranges are input as percentages. Scoring on the installation level would enable the professional who knows the most about a particular waste to input needed information. This would also allow the installations or commands to prioritize specific hazardous materials even if the overall DA prioritization may slight their hazardous waste problems due to comparatively low volumes. Use of the HMPM would also address the problem of overall volumes for specific wastes. The need for accurate, complete, and detailed hazardous material reporting on all levels is inseparable from the success of prioritization and the hazardous waste minimization program. If accurate records that address the issues of the HMPM are established and maintained, the HMPM will be relatively simple to use.

An example of the HMPM using PCBs is included in Appendix G. PCBs scored 73 points out of 100 using the HMPM, a relatively high priority, due to its high overall volume, acute and chronic toxicity, persistence in the environment, and the readily available, less toxic substitute-mineral transformer oil. Indeed, PCBs should score high because these substances obviously are a public health issue and are being replaced in all aspects of industrial applications. Other wastes were also rated with assumed values. Spent solvent (methyl chloride) and PCP-contaminated ammunition boxes scored 78 points and 62 points, respectively.

It should be understood that HMPM was an attempt to consider other important factors in lieu of the Army's current method based solely on quantity. However, shortcomings include: (1) the weighted point for each factor was empirically developed without any supporting theoretical basis and (2) considering the complexity and risks of a hazardous waste management system, the factors selected in this HMPM were oversimplified and still reflected only a partial picture of the Army's hazardous waste problem.

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[9]40 CFR, Part 261, Environmental Protection Agency, Regulation for Identifying Hazardous Waste.

5 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

As a result of record reviews, field interviews, and data analysis, the findings are summarized as follows:

- Hazardous waste generation quantity data increases (by 8 percent from CY 85 to CY 86 and by 37 percent from CY 86 to CY 87) are due to increases in report quantity, not in actual quantity generated.

- The best records on the amounts of hazardous waste generated and disposed of are those reported for 1987. Incomplete and inadequate records for 1985 and 1986 make data from these periods doubtful.

- Hazardous waste reports that installations currently submit to regulatory agencies can provide hazardous waste information to satisfy future data base requirements.

- Internal waste manifest forms are necessary for tracking hazardous waste generation, treatment, storage, and disposal at installations.

- The DD Form 1348-1 provides a record of materials and wastes being disposed of off an installation, but does not contain data on the amount of waste being treated at the installation. An installation waste manifest form would provide additional information on generation, storage, treatment, and disposal.

- Army regulations and guidelines outline manifesting and hazardous waste record-keeping procedures. Installations should follow these requirements and the quantity reported should be consistent among different reports.

- Specific guidelines are needed on how industrial sludges should be reported (i.e., dry weight, wet weight, before or after treatment volume, etc.).

- Records of hazardous materials coming onto an installation by local purchases are inadequate.

- Certain materials shipped from DLA depots are hazardous even though a suitable nonhazardous substitute can be procured for military use.

- Once a material is declared a "hazardous waste," too much time is taken before the items are removed from the installation by the servicing DRMO. Most installations do not have long-term approved storage and are subject to receiving a "Notice of Violation" from State regulatory agencies when the 90 days of temporary storage is exceeded.

- Specifications can require AMC production and maintenance activities to use hazardous materials even when nonhazardous substitute materials might exist.

- Installation Hazardous Waste Minimization Boards that are composed of staff personnel often do not function effectively due to the lack of authority given to the Installation Environmental Coordinator who is normally the Board Chairman.

• The priority ranking methodology as developed considers the Army as a whole to ensure that the various types and sizes of installations share an equitable priority consideration, while still attempting to establish those waste streams that need the most attention Armywide. Since the personnel using the methodology may not necessarily be technically oriented engineers and scientists, the method is simplified into a weighted point system with supplemental information so the user will have readily available the necessary data to answer questions relative to prioritization values.

Recommendations

• The definition of hazardous waste generation quantity should be refined to meet the need of hazardous waste minimization performance monitoring. It is suggested that generation quantities be divided into RCRA wastes, state unique wastes, and nonrecurring wastes. Also, consideration should be given to include treatment and recycling quantities in hazardous waste minimization data.

• Department of the Army and DLA need to establish a procedure on how the DRMOs are to report back to the installations the amount of materials classified and disposed of as hazardous wastes.

• A pamphlet is needed, for distribution to and use by installations, which details the definition of a hazardous waste according to DRMS, and explains how an item turned over to DRMO goes through the DRMS system and may eventually be declared a hazardous waste.

• High-level DOD/Army/DLA action is needed to resolve the conflicts and time delays in awarding contracts for hazardous waste pickup and disposal from installations.

• The MACOMs and installations need to fulfill the requirements to manifest their wastes at the "point of generation" as defined by the AEO message, Army Regulations, and 40 CFR, Parts 260-280.

• The MACOMs should consider using the sample internal manifest (Appendix C) to track hazardous wastes and compile future data.

• The Army hazardous waste minimization progress should be measured by comparing the total hazardous waste minimization quantity and the actual annual hazardous waste generation quantity.

• The HMPM can be adopted as a support tool to establish Armywide, MACOM, or installation hazardous waste minimization priorities. Local environmental personnel and/or potential public health issues may identify specific hazardous material and disposal handling problems that the DA level prioritization may not recognize.

• Installations should institute a procedure requiring a supervisor to certify that a material requisition does not contain any hazardous constituents to better control procurement of hazardous materials through the "local procurement" processes.

• DLA should remove hazardous materials from depot inventories when nonhazardous substitutes are available.

- The Army should review military specifications requiring use of hazardous materials and eliminate their use where possible. Contracts awarded to government owned, contractor operated plants should be modified to encourage elimination of hazardous materials when safe substitutes, which do not affect the end product, are available.

- Command emphasis is needed to ensure good hazardous waste management and minimization programs. Installation commanders' support to their environmental coordinators will be critical when disposal funding is decentralized.

- If organizations require additional data or special reports to supplement past or current reports, installations should be requested to complete a simple, fill-in-the-blank report.

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APPENDIX A:
SAMPLE ARMY ENVIRONMENTAL MESSAGE TO MAJOR COMMANDS

UNCLASSIFIED

01 04 NOV 87 RR RR UUUU

DA WASH DC//CEHSC-E//

AIG 7406/AIG7405/AIG7446//

CNGB WASHINGTON DC//NGB-ARI-E//

INFO: DA WASH DC//SAIL/JALS-RL/SAGC//

DALO-SMP/CEHSC-FU/SAFM-BU//

CDRUSACERL CHAMPAIGN IL//

CDRUSAEHA APG MD//HSHB-ME-SH//

DLA CAMERON STATION VA//DLA-WS/DEPO//

UNCLAS

SUBJECT: REPORT TO CONGRESS ON HAZARDOUS WASTE MINIMIZATION

1. THE HOUSE APPROPRIATIONS COMMITTEE HAS DIRECTED THE DEPARTMENT OF DEFENSE (DOD), ALONG WITH THE U.S. ENVIRONMENTAL PROTECTION AGENCY, TO DEVELOP AN AGGRESSIVE WASTE REDUCTION PROGRAM WITH SPECIFIC REDUCTION

NANCY POMERLEAU, EPS, CEHSC-E COME BACK COPY

694-0591

RONALD G. KELSEY, COL, CHIEF, ASO

UNCLASSIFIED

02 04 NOV 87 RR RR UUUU

GOALS FOR SPECIFIC CATEGORIES OF HAZARDOUS WASTE AND FACILITIES. ACCORDINGLY, THE COMMITTEE REQUESTS A REPORT BY MARCH 31, 1988, ON THE STATUS OF SUCH A WASTE MINIMIZATION PROGRAM/SPECIAL FACILITIES. SUBJECT REPORT SHALL INCLUDE AN OUTLINE OF THE PROGRAM BY INDIVIDUAL MILITARY SERVICES AND INSTALLATIONS WHICH CAN REASONABLY BE EXPECTED TO REDUCE HAZARDOUS WASTE BY TEN PERCENT PER YEAR IN EACH OF THE NEXT FIVE YEARS. ALSO, THE REPORT SHOULD INCLUDE A SUMMARY OF ACHIEVEMENTS AND PROPOSED ACTIONS WHICH CAN BE EXPECTED TO FURTHER REDUCE WASTE GENERATION OVER THE NEXT FIVE YEARS.

2. THIS HEADQUARTERS, WITH THE ASSISTANCE OF V. J. CICCONE AND ASSOC., INC. WOODBRIDGE, VA, INTENDS TO PROVIDE A REPORT TO ASA {I&L} FOR DOD BY MARCH 15, 1988, FOR ARMY FACILITIES LOCATED WORLDWIDE, THAT ADDRESSES THE COMMITTEE'S REQUEST. TO FACILITATE THIS EFFORT, INSTALLATIONS ARE REQUESTED TO PROVIDE THE FOLLOWING INFORMATION ON HAZARDOUS WASTES, AS DEFINED BY TITLE 40 CODE OF FEDERAL REGULATIONS, PART 261.3 AND BY THE RESPECTIVE STATES IN WHICH THE HAZARDOUS WASTE IS GENERATED, FOR CALENDAR YEARS 1985, 1986, AND 1987. THE MACOMS WILL REPORT THE INFORMATION TO THIS HEADQUARTERS, ARMY ENVIRONMENTAL OFFICE, ATTN: CEHSC-E, NO LATER THAN 15 JAN 88. IN ALL CASES, TYPE OF WASTE MEANS THE HAZARDOUS WASTE CODE IN 40 CFR PART 261 AND QUANTITY MEANS TONS OR GALLONS.

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A. INSTALLATION NAME.

B. QUANTITY OF WASTE GENERATED.

C. QUANTITY AND TYPE OF WASTE GENERATED ON-SITE.

D. QUANTITY AND TYPE OF WASTE RECEIVED FROM OFF-SITE.

E. QUANTITY OF WASTE TREATED ON-SITE BY TYPE OF UNIT {E.G., INCINERATOR, LANDFILL, WASTE PILE}.

F. QUANTITY AND TYPE OF WASTE DISPOSED OF ON-SITE BY TYPE OF UNIT.

G. QUANTITY AND TYPE OF WASTE STORED ON-SITE BY DRMO.

H. QUANTITY AND TYPE OF WASTE STORED OFF-SITE BY DRMO.

I. QUANTITY AND TYPE OF WASTE STORED ON-SITE BY THE INSTALLATION.

J. QUANTITY AND TYPE OF WASTE RECYCLED, REUSED, OR RECLAIMED ON-SITE.

K. QUANTITY AND TYPE OF WASTE SHIPPED OFF-SITE AND TYPE OF DISPOSAL OR TREATMENT UNIT.

L. QUANTITY AND TYPE OF WASTE RECYCLED, REUSED, OR RECLAIMED OFF-SITE.

M. PROVIDE OFF-SITE DISPOSAL COSTS FOR PARA 2K ABOVE.

N. PROVIDE OFF-SITE COSTS FOR RECYCLING, REUSE, OR RECLAMATION FOR PARA 2L ABOVE.

O. BRIEF DESCRIPTION OF HAZARDOUS WASTE MINIMIZATION INITIATIVES{S}, {EXISTING VERSUS PROPOSED} INCLUDING PROJECTED WASTE REDUCTION IN TERMS OF QUANTITY AND/OR TOXICITY, YEAR OF PROJECT IMPLEMENTATION, EXPECTED ANNUAL DOLLAR SAVINGS, COST TO IMPLEMENT THE PROJECT, AND SPECIFIC SOURCES OF FUNDING {NOT

DERA) FOR PROJECT (OMA, OPA MCA, PAA, RDT&E, ETC.). SPECIFY WHETHER THE PROJECT(S) INVOLVE SOURCE REDUCTION OR END-OF-PIPE TREATMENT.

P. BRIEF EXPLANATION OF IMPEDIMENTS TO WASTE MINIMIZATION, SUCH AS ARMY REGULATIONS.

Q. BRIEF EXPLANATION OF INCENTIVES/SPECIAL FACILITIES NEEDED TO SUPPORT HAZARDOUS WASTES MINIMIZATION.

3. POC IS MS. NANCY POMERLEAU, AV/224-3434.

UNCLASSIFIED

APPENDIX B:
HAZARDOUS WASTE DATA VALIDATION QUESTIONNAIRE

1. Do you understand the purpose of DA asking for the information on hazardous waste generation and waste minimization?

2. What do you understand is the purpose of the hazardous waste minimization program? (response -- to reduce the threat to the environment and human health)

3. Is there confusion on what to report or categorize as a hazardous waste?

4. Do you use the USEPA List of hazardous wastes -- 40 CFR 261?
   Do you understand the 10 Waste Types used by AMC?

5. Would examples of various items found in the ten different waste categories help you in reporting and categorizing hazardous wastes?

6. How was the data generated for your response to the hazardous waste profile?
   From routine internal reports?
   From reports previously generated for a higher command?
   From a one-time special request specifically for this purpose?
   Other?

7. How was the information gathered for your hazardous waste profile?
   From routine existing reports?
   From new requests to waste managers, etc.?

8. Are there other (what other) reports filled out that supply hazardous waste information?
   To DOD?
   To DA?
   To MACOM?
   To USEPA?
   To Federal agencies?
   To State?
   To Local?

9. Can you consolidate information from other currently required reports to prepare a hazardous waste profile and minimization type report for DA?

10. Are there any areas of waste management that were not reported in your profile that should be supplied to DA?

11. How long did you have to prepare the response to the report to congress once the message (TWX) was received?

12. How long did it take you (man-hours) to actually prepare the hazardous waste profile?

13. How (do you) (does your) installation view this HAZMIN STATUS PROFILE in terms of its usefulness in identifying new (or existing) problems?

14. Did you see the HAZMIN STATUS PROFILE as a means to identify waste management problems? Potential waste minimization actions?

15. Should future requests for hazardous waste information present minimization examples so that both the generation and reduction will be better portrayed?

16. How did you calculate or compile the data to determine amounts (and types) of wastes?

17. Is there a tracking method for determining waste generation, treatment, storage, disposal, recycling at your facility?

18. What measuring method do you use to determine amounts generated, treated, disposed, stored, or recycled?

19. Is your data an accurate representation of measured or calculated amounts or is it a best estimate?

20. Is your data on waste characterization (USEPA List 40 CFR 261) based upon material balance, inventory control or chemical analysis? What method, sampling method, lab etc., analysis is used to identify the wastes generated?

21. If you do a material balance per question 20, is there any attempt made to resolve conflict in the numbers?

(haz. materials in ------ haz. wastes out)

22. Would it have been (better) (easier) from your standpoint to present a prestructured form for you to fill out which requests information on hazardous waste generation, treatment, etc.?

Would a matrix format work better than a questionnaire type form?

23. Would you use conversion factors for conversions (i.e., pounds to metric tons) if they were presented for your use when responding to the questionnaire?

Especially if a matrix format is presented to you?

24. What units of measurements were used by you when you responded to the questionnaire? Why these units? (From previous reports?)

25. How do you determine the amount of hazardous waste stored?

26. How do you determine the amount of hazardous waste treated?

27. How do you determine the amount of hazardous waste recycled?

28. How do you determine the amount of hazardous waste allocated for disposal?

29. What kind of sludges are you reporting? Do they accurately reflect your situation?

30. How do you determine the amount of a specific hazardous waste sludge which is shipped off-site?

31. Do you report wet or dry weight sludges?

32. What kind of industrial liquid wastes are you reporting?

33. What specific hazardous waste management procedures are employed at the installation?

34. Who manages the wastes?

35. Show a diagram of management, and waste handler waste reporting responsibility which includes supervisory level activities.

36. What was the data source of your CY 85 hazardous waste profile data?

37. Do you maintain records of waste generation, treatment, storage, and disposal back to 1985 (or farther)?

38. How are the wastes of tenant organizations managed?
(Show waste flow by diagram)

39. How are these wastes accounted for?

40. Who is responsible for the management, tracking, handling, and accounting for tenant generated waste?

41. Do you feel that the (installation)(environmental office) is receiving command support for waste management/reduction? Is the support in the form of funding, management direction, handling, and/or treatment methods?

42. What is the installation's relationship with the DRMO?

43. Approximately how much material is turned over to DRMO as a hazardous material, but subsequently becomes classified as a hazardous waste?

44. Are you informed by DRMO of hazardous waste amounts and types charged to your installation?

45. Are you informed by DRMO of the costs of various treatment, disposal actions which relate to hazardous materials/wastes turned in to DRMO by your installation?

46. How easy (difficult) is it to obtain DRMO information on quantities, costs, fate of wastes?

47. Is the material/waste being accurately accounted for by the installation (prior) (after) turn-in to DRMO?

48. What changes to the present procedures for tracking through DRMO should be made?

49. Do you understand how the waste minimization program might allow value engineering credit?

50. Do you document cost savings? (of minimization actions)
Projected cost savings?

51. Do you know how to project cost savings or cost benefit analyses for minimization actions?

52. Do you know that beginning in FY 90, installations become directly responsible for paying the costs of installation waste disposal?

53. Is there an area of hazardous waste management that you want to discuss here?

54. How difficult would it be to track a selected waste at your installation from purchase to ultimate disposal (cradle-to-grave)? Can this be done by diagram (PERT/CPM etc. or similar) to show:

origin
use
waste flow
cleanup
time
cost of purchase
cost of disposal
responsible using person/waste handlers involved
ultimate fate

55. Are your hazardous wastes predominately in solid or liquid form?

56. What percentage of your liquid hazardous wastes occur in a water based form?

57. What percentage of your liquid hazardous wastes occur in a non-water (solvent, oil, grease) based form?

58. What percentage of your solid hazardous waste contains toxic heavy metals (e.g., Pb, As, Cd, Hg)? Of the liquid waste? How do you determine this?

59. What percentage of your hazardous waste (solid and liquid) contains pesticides?

60. What percentage of your hazardous waste presents an odor problem to:
the surrounding areas?
waste handlers?

61. What transportation problems do you encounter with waste disposal or storage?
    Appropriate vehicles?
    Appropriate or sufficient containers?
    Route of travel?
    Distance to appropriate facility?
    Space availability?

62. Are there currently available waste minimization technologies or practices which your installation needs and could support that are not now in place?

63. Are there plans and schedules developed to implement these methodologies?

64. What percentage (based on volume) of your hazardous waste is viewed to be moderately or highly toxic?

65. What do you consider to be your three most dangerous wastes?

66. What are the three to five most significant or troublesome waste handling and minimization problems you routinely face?

APPENDIX C:
PROPOSED INTERNAL MANIFEST FORM

GENERATOR Date of Collection _____

Generator's Name _____ Bldg. No. _____

Generator's Code _____ Rm. No. _____

Source and/or Production Area of Waste _____

Description of Waste _____

Solid _____ Liquid _____ Explosives _____ Heavy Metal _____

Other _____ Specific Gravity _____

Name of Material/Waste _____

If material is a mixture or denoted by a trade name, list the name and the components and the respective percentages:

Substances and percentages: _____

_____

_____

Manufacturer _____ Phone No. _____

City, State _____

Hazardous Properties and Warnings listed on the container _____

Attach a material Safety Data Sheet (MSDS) if available

Type and Size of container _____

Quantity (Specify unit of measure) _____

Weight _____ (specify units)

RELEASED BY _____ Phone No. _____

_____

FOR ENVIRONMENTAL OFFICE USE ONLY

Date Transported to TDS site _____

Storage Area Location _____

Treatment Area Location _____

Date Disposed of by Treatment _____

Any residual waste from treatment? _____

Disposal Site _____

DOT Proper Shipping Name _____

DOT Hazard Class _____ DOT I. D. No. _____

DOT Required Label _____

EPA I. D. No. _____

Date signed for by DRMO _____

Date removed from storage site _____

DD Form 1348-1 Date and Serial No. _____

Transported to Disposal by _____

Copies: 1 to Env. Office; 1 to Generator:

1 to accompany waste to Treatment Disposal Site (TDS)

APPENDIX D:
PROPOSED HAZARDOUS WASTE PRIORITIZATION FORM

NAME OF MATERIAL
DESCRIPTION
PURPOSE OF MATERIAL OR SOURCE

SPECIFIC GRAVITY

NOTE: ALL FOLLOWING SHEETS ARE SHOWN WITH ANSWERS AND VALUES AT MAX, BUT MAX SCORE CAN ONLY BE 100

(1) COST (3-23)

		Place x in this column	
(a) Volume	>10% yr	x	10
	5% yr	x	8
	3% yr	x	6
	1% yr	x	6
	0.5% yr	x	6
	< 0.1% yr	x	6

(b) Treatability — Put Yes or no in block below

(i) Is there an accepted method of treatment?

yes	2

(ii) Is this treatment method economically feasable?

yes	2

(iii) Is this treatment acceptable by DOD policy?

yes	2

(iv) Does the resulting waste represent a disposal problem?

no	2

(c) Cost of Disposal

	place x in this column	
>$200/mt	x	5
$150-199/mt	x	4
$50-149/mt	x	3
<$50/mt	x	2

TOTAL SCORE FOR COST= 64

(2) FATE/MOBILITY (4-21)

(a) physical state at 20 C

	place x in this column	
solid	x	1
liquid	x	3
gas	x	5

(b) Containment

	place x in this column	
lagoon/outfall	x	7
landfill/underground tanks	x	5
drums/above ground tanks	x	3
miscellaneous	x	1

(c) Volatility

	place x in this column	
(>500 mm Hg volatile with odor	x	4
(<500 mmHg) volatile without odor	x	2
(<250 mmHg) non-volatile	x	0

(d) Persistence

	place x in this column	
log Kow>=5.0	x	5
log Kow>=3.0	x	4
log Kow>=2.0	x	3
log Kow>=1.0	x	2
log Kow <1.0	x	1

TOTAL SCORE FOR FATE/MOBILITY= 46

(3) PUBLIC HEALTH THREAT (1-31)

(a) Toxicity

	place yes/no below	
Carcinogen?	yes	10

	place x in this column	
Mammalian LD50:		
>5,000 mg/kg	x	1
1,000-4,999 mg/kg	x	2
500-999 mg/kg	x	3
100-499 mg/kg	x	4
<100 mg/kg	x	6

Aquatic Toxicity:	place yes/no below	
(LD50 <1,000 mg/L) toxic?	yes	2
(LD50 >1,000 mg/L) non-toxic	yes	0
unknown	yes	1

(b) Hazard

	place yes/no below	
Ignitable/Explosive?	yes	2
Reactive?	yes	2
Corrosive?	yes	2
Radioactive?	yes	2

(c) Public Health Issues

	place yes/no below	
Priority Pollutant List?	yes	3
Known Public Health Issue? (ie - Chemical/biological warfare agents, etc.)	yes	3

TOTAL SCORE OF PUBLIC HEALTH ISSUES=	43

(4) ESSENTIALITY (0-24)

(a) Is the process causing the waste essential to operations?	no	3
(b) Is there a technoligcally acceptable substitute?	yes	3
(c) Will the treatment of substitute cause a disposal problem?	no	3
(d) Is the substitution economically feasable?	yes	3
(e) Is the substitute acceptable by DOD policy?	yes	3
(f) Is the substitute less toxic than the original?	yes	3
(g) Will the substitute significantly decrease the quality of the product?	no	3
(h) Is the substitute available for DOD use?	yes	3

TOTAL FOR ESSENTIALITY=	24
TOTAL HAZMIN PRIORITIZATION SCORE=	100
RATIO OF TOTAL SCORE TO POSSIBLE SCORE=	1

APPENDIX E:
CARCINOGEN LIST

Acetamide
Acetophenetidin
Acrylamide
Acrylonitrile
Actinomycin D
Adriamycin
Aflatoxins
Aldrin
2-Aminoanthraquinone
4-Aminobiphenyl
3-Amino-9-ethylcarbazole
1-Amino-2-methylanthraquinone
4-Amino-2-nitrophenol
3-Amino-1,2,4-triazole
Antimony trioxide
0-Ansidine hydrochloride
Asbestos
Arsenic and arsenic compounds
Azobenzene
Auramine

Benz (a) anthracene
Benzene
Benzidine
Benzo (a) pyrene
Benzyl chloride
Beryllium and compounds
Bis (2-chloroisopropyl) ether
Bis (chloromethyl) ether
Bromodichloromethane
Bromoform
Butadiene
tert-Butyl chromate

Cadmium and compounds
Calcium arsenate
Captan
Carbaryl
Carbon tetrachloride
Chloramben
Chlorambucil
Chlordane
Chlordecone
Chornaphazine
p-Chlorobenzotrichloride
Chloroform
Chloromethyl methyl ether
Chloroprene
Chromium and compounds
Chrysene
Cinnamyl anthranilate
Citrus Red 2
Coal tar pitch volatiles
Cresote
Cresidine
Cupferron
Cycasin
Cyclophosphamide

DDT
Diallate
2,4-Diaminoanisole
2,4-Diaminoazobenzene
Diazomethane
Dibromochloropropane
3,3'-Dichlorobenzidine and salts
2,3-Dichloro-1,4-dioxane
Dichloroethyl ether
Dieldrin
Diepoxybutane
Di(2-ethylhexyl) phthalate
Diethylstilbestrol
Dihydrosafrole
Dimethoxane
Dimethoxybenzidine
4-Dimethylaminoazobenzene
3-3'-Dimethylhydrazine
Dimethyl carbanoyl chloride
2,6-Dinitrophenol
1,1-dimethyl hydrazine
Dioctylphthalate
Dimethyl sulfate
1,2-Diphenylhydrazine
2,4-Dinitrotoluene
Direct Blue 6
Dioxane
Direct Black 38

Epichlorohydrin
Ethylene dichloride
Ethylene thiourea
Ethylene dibromide
Ethyleneimine

N-2-Fluorenyl acetamide
Formaldehyde

Hematite
Hexachlorobenzene
Hexachlorocyclohexane
Hexamethylphosphoric triamide
Heptachlor
Hexachlorobutadiene
Hexachloroethane
Hydrazine

Iron-Dextran
Isopropyl oils

Lead acetate
Lindane
Lead phosphate

Maneb
Methyl bromide
4,4'-Methylenebis
(2-chloroaniline)
Methylene chloride
Michler's ketone
Mustard gas
Melphalan
Methyl chloride
4,4'-Methylenebis
(N,N-dimethyl)aniline
Methyl iodide
Mirex

a-Naphthylamine
Nickel and soluble compounds
Nitrilotriacetic acid
4-nitro biphenyl
o-Nitrochlorobenzene
Nitrofen
Nitrosamines
b-Napthylamine
Nickel carbonyl
5-Nitro-o-anisidine
p-Nitrochlorobenzene
2-Nitropropane
N-Nitrosodimethylamine

Oxymetholone

Paraffin
Phenazopyridine hydrochloride
Phenyl-B-napththylamine
Picloram
Polychlorinated biphenyls
Procarbazine
B-Propiolactone
Propylene oxide
Pentachloronitrobenzene
Phenylhydrazine
Phenytoin
Polybrominated biphenyls
Polynuclear aromatic hydrocarbons
Propane sultone
Propyleneimine

Quioline

Reserpine

Saccharin
Selenium sulfide
Safrole
Soot

Streptozotocin	Sulfallate
Sulfurous acid-2-(p-t-butylphenoxy)-1-methylethyl-2-chloroethyl ester	
2,4,5,-T	Tannic acid
TDE	Testosterone
Tetrachlorodibenzo-p-dioxin	1,1,2,2-Tetrachloroethane
Tetrachloroethylene	Thioacetamide
Thiotepa	Thiourea
Thorium dioxide	0-Tolidine
Toluene-2,4-diamine	o-Toluidine
Toxaphene	1,1,2-Trichloroethane
Trichloroethylene	2,4,6-Trichlorophenol
Trifluralin	Tris(2,3-dibromopropyl) phosphate
Urethane	
Vinyl bromide	Vinyl chloride
Vinyl cyclohexene dioxide	Vinylidene chloride
Zinc chromate	Ziram

APPENDIX F:
PRIORITY POLLUTANTS

Percent of Samples	Number of Industrial Categories	Name
	31 are purgeable organics	
1.2	5	Acrolein
2.7	10	Acrylonitrile
29.1	25	Benzene
29.3	28	Toluene
16.7	24	Ethylbenzene
7.7	14	Carbon tetrachloride
5.0	10	Chlorobenzene
6.5	16	1,2-Dichloroethane
10.2	25	1,1,1-Trichloroethane
1.4	8	1,1-Dichloroethane
7.7	17	1,1-Dichloroethylene
1.9	12	1,1,2-Trichloroethane
4.2	13	1,1,2,2-Tetrachloroethane
0.4	2	Chloroethane
1.5	1	2-Chloroethyl vinyl ether
40.2	28	Chloroform
2.1	5	1,2-Dichloropropane
1.0	5	1,3-Dichloropropene
34.2	25	Methylene chloride
1.9	6	Methyl chloride
0.1	1	Methyl bromide
1.9	12	Bromoform
4.3	17	Dichlorobromomethane
6.8	11	Trichlorofluoromethane
0.3	4	Dichlorodifluoromethane
2.5	15	Chlorodibromomethane
10.2	19	Tetrachloroethylene
10.5	21	Trichloroethylene
0.2	2	Vinyl chloride
7.7	18	1,2-trans-Dichloroethylene
0.1	2	bis(Chloromethyl) ether
6.0	9	1,2-Dichlorobenzene
		1,3-Dichlorobenzene
		1,4-Dichlorobenzene
0.5	5	Hexachloroethane

Percent of Samples	Number of Industrial Categories	Name
	46 are base/neutral extractable organic compounds	
0.2	1	Hexachlorobutadiene
1.1	7	Hexachlorobenzene
1.0	6	1,2,4-Trichlorobenzene
0.4	3	bis(2-Chloroethoxy) methane
10.6	18	Naphthalene 0.99
0.9	9	2-Chloronaphthalene
1.5	13	Isophorone
1.8	9	Nitrobenzene
1.1	3	2.4-Dinitrotoluene
1.5	9	2,6-Dinitroluene
5.7	11	Fluorene
7.2	12	Fluoranthene
5.1	9	Chrysene
7.8	14	Pyrene
10.6	16	Phenanthrene
		Anthracene
2.3	6	Benzo(a)Anthracene
1.6	6	Benzo(b)fluoranthene
1.8	6	Benzo(k)fluoranthene
3.2	8	Benzo(a)pyrene
0.8	4	Indeno (1,2,3-c,d)pyrene
0.2	4	ibenzo(a,h)anthracene
0.6	7	Benzo(g,h,i)perylene
0.1	2	4-Chlorophenyl phenyl ether
		3,3'-dichlorobenzidene
		bis (2-chloroethyl)ether
		benzidene
0.8	7	1,2-Diphenylhydrazine
0.1	1	Hexachlorocyclopentadiene
1.2	5	N-Nitrosodiphenylamine
4.5	12	Acenaphthylene
4.2	14	Acenaphthene
8.5	13	Butyl benzyl phthalate
0.1	1	N-Nitrosodimethylamine
0.1	2	N-Nitrosodi-n-propylamine
0.1	2	N-Nitrosodi-n-propylamine
1.4	6	bis(2-Chloroisopropyl) ether
		Di-n-butyl Phthalate
		Diethyl phthalate4-Bromophenyl-phenyl ether

Percent of Samples	Number of Industrial Categories	Name
		bis (2-ethylhexyl)phthalate
		Di-n-octyl phthalate
		Dimethyl phthalate
26.1	25	Phenol
2.3	11	2-Nitrophenol
2.2	9	4-Nitrophenol
1.6	6	2,4-Dinitrophenol
1.1	6	4,6-Dinitro-o-cresol
6.9	18	Pentachlorophenol
1.9	8	p-Chloro-m-cresol
2.3	10	2-Chlorophenol
3.3	12	2,4-Dichlorophenol
4.6	12	2,4,6-Trichlorophenol
5.2	15	2,4-Dimethylphenol
	26 are pesticides/PCBs	
0.3	3	a-Endosulfan
0.4	4	B-Endosulfan
0.2	2	Endosulfan sulfate
0.6	4	a-BHC
0.8	6	B-BHC
0.2	4	o-BHC
		y-BHC
0.5	5	Aldrin
0.1	3	Dieldrin
0.04	1	4,4'-DDE
0.1	2	4,4-DDD
0.2	2	4,4'-DDT
		Endrin
		Endrin aldehyde
0.3	3	Heptachlor
0.1	1	Heptachlor epoxide
0.2	4	Chlordane
0.2	2	Toxaphene
0.6	2	Aroclor 1016
0.5	1	Aroclor 1221
0.9	2	Aroclor 1232
0.8	3	Aroclor 1242
0.6	2	Aroclor 1248
0.6	3	Aroclor 1254
		Arochlor 1260

Percent of Samples*	Number of Industrial Categories	Name
0.5	1	2,3,7,8-Tetrachlorodi-benzo-p-dioxin (TCDD)
	13 are metals	
18.1	20	Antimony
19.9	19	Arsenic
14.1	18	Beryllium
30.7	25	Cadmium
53.7	28	Chromium
55.5	28	Copper
43.8	27	Lead
16.5	20	Mercury
34.7	27	Nickel
18.9	21	Selenium
22.9	25	Silver
19.2	19	Thalium
54.6	28	Zinc
	Miscellaneous	
33.4	19	Total cyanides Asbestos (fibrous)

*The percent of samples represents the number of times this compound was found in all samples in which it was analyzed for, divided by the total as of 31 August 1978. Numbers of samples ranged from 2532 to 22998 with the average being 2617. Thirty-two industrial categories and subcategories were analyzed for organics and 28 for metals as of 31 August 1978.

APPENDIX G:
PRIORITIZATION EXAMPLE

NAME OF MATERIAL Spent Solvent
DESCRIPTION Methylene Chloride
PURPOSE OF MATERIAL OR SOURCE Solvent for degreasing of parts and equipment

SPECIFIC GRAVITY 0.8

(1) COST (3-23)

(a) Volume

	Place x in this column	
>10% yr	x	10
5% yr		0
3% yr		0
1% yr		0
0.5% yr		0
< 0.1% yr		0

(b) Treatability

Put Yes or no in block below

(i) Is there an accepted method of treatment?

yes	2

(ii) Is this treatment method economically feasable?

yes	2

(iii) Is this treatment acceptable by DOD policy?

yes	2

(iv) Does the resulting waste represent a disposal problem?

no	2

(c) Cost of Disposal

	place x in this column	
>$200/mt		0
$150-199/mt	x	4
$50-149/mt		0
<$50/mt		0

TOTAL SCORE FOR COST=	22

(2) FATE/MOBILITY (4-21)

(a) physical state at 20 C

	place x in this column
solid	0
liquid	x 3
gas	0

(b) Containment

	place x in this column
lagoon/outfall/sludge	0
landfill/underground tanks	0
drums/above ground tanks	x 3
miscellaneous	0

(c) Volatility

	place x in this column
(>500 mm Hg volatile with odor	x 4
(<500 mmHg) volatile without odor	0
(<250 mmHg) non-volatile	0

(d) Persistence

	place x in this column
log Kow>=5.0	0
log Kow>=3.0	x 4
log Kow>=2.0	0
log Kow>=1.0	0
log Kow <1.0	0

TOTAL SCORE FOR FATE/MOBILITY= 14

(3) PUBLIC HEALTH THREAT (1-31)

(a) Toxicity

	place yes/no below	
Carcinogen?	yes	10

	place x in this column	
Mammalian LD50:		
>5,000 mg/kg		0
1,000-4,999 mg/kg		0
500-999 mg/kg		0
100-499 mg/kg	x	4
<100 mg/kg		0

	place yes/no below	
Aquatic Toxicity:		
(LD50 <1,000 mg/L) toxic?	yes	2
(LD50 >1,000 mg/L) non-toxic	no	0
unknown	no	0

(b) Hazard

	place yes/no below	
Ignitable/Explosive?	yes	2
Reactive?	no	0
Corrosive?	no	0
Radioactive?	no	0

(c) Public Health Issues

	place yes/no below	
Priority Pollutant List?	yes	3
Known Public Health Issue? (ie - Chemical/biological warfare agents, etc.)	no	0

TOTAL SCORE OF PUBLIC HEALTH ISSUES= 21

(4) ESSENTIALITY (0-24)

(a) Is the process causing the waste essential to operations?	no	3
(b) Is there a technoligcally acceptable substitute?	yes	3
(c) Will the treatment of substitute cause a disposal problem?	no	3
(d) Is the substitution economically feasable?	yes	3
(e) Is the substitute acceptable by DOD policy?	yes	3
(f) Is the substitute less toxic than the original?	no	0
(g) Will the substitute significantly decrease the quality of the product?	no	3
(h) Is the substitute available for DOD use?	yes	3

TOTAL FOR ESSENTIALITY=	21
TOTAL HAZMIN PRIORITIZATION SCORE=	78
RATIO OF TOTAL SCORE TO POSSIBLE SCORE=	0.78

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